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United States Department of Agriculture,

DIVISION OF ENTOMOLOGY,

L. O. HOWARD, Entomologist.

THE STRIPED CUCUMBER BEETLE.

(Diabrotica vittata Fab.)By F. H. CHITTENDEN,
Entomologist in Charge of Breeding Experiments.

GENERAL APPEARANCE AND NATURE OF ATTACK.

Early in the season with the first appearance of cucumber, squash, and melon plants, often before they are above ground, they are attacked by a little yellow and black-striped insect, known as the striped cucumber beetle, "striped bug," "melon bug," etc. The principal injury is effected by the mature insects at this time, and is also caused later by the larvæ feeding underground upon the roots and stems of the same plants.

The beetle, illustrated at figure 1, *a*, is quite small, measuring about two-fifths of an inch in length and half as much in width. Its color is yellow above, with black

stripe running longitudinally on each side of each wing-cover, producing the effect of a three-striped back. The under surface is mostly black and portions of the legs and antennæ are also marked with black.

The striped cucumber beetle is indigenous to this country and inhabits the entire eastern United States from the Canadian border to Mexico. It has been reported as injurious in all except a few States east of the Rocky Mountains and to occur in the State of Washington.

The most apparent form of injury effected is through the first appearing or hibernating generation of beetles burrowing down to meet the plants before they show above ground and in feeding upon the tender plants before they have fairly started. The beetles are also destructive to older plants, by eating the leaves and especially by gnawing around and consuming the epidermis of the stems, and the larvæ are often the

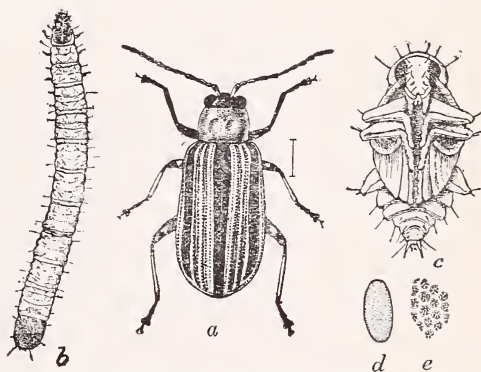


FIG. 1.—*Diabrotica vittata*: *a*, beetle; *b*, larva; *c*, pupa; *d*, egg; *e*, sculpture of same—*a*, *b*, *c*, much enlarged, *d*, more enlarged, *e*, highly magnified (author's illustration).

cause of injury through their unseen but none the less pernicious work at the roots. Another form of mischief is caused by the beetles acting as carriers of the bacterial wilt disease¹ of cucurbits, cotton, and cowpea.

The subterranean habit of the larvæ make it certain that they are more often than not at the roots of cucurbits without the knowledge of the farmer or gardener, the outward manifestation of their presence being the wilting of the leaves and the failure of the plants to develop perfect fruit. Far too often the debility or death of the vines through the presence of this insect is attributed to dry weather or some similar natural cause. Injury, then, is threefold, due: (1) to direct attack by the beetles to the plant above the roots; (2) indirectly to the beetles as transmitters of disease germs; (3) to the larvæ working upon the roots underground.

FOOD PLANTS.

This cucumber beetle is rarely absent from the farm and garden over an area which embraces nearly our whole country, and is by far more common and more destructive than any other cucurbit pest with which we have to deal. Hubbard and marrow squashes are favorites, followed by cucumbers and canteloupes. Other cucurbits, such as pumpkins and watermelons, are also subject to injury by the beetles and larvæ. It is not alone in the field and garden that this species is troublesome, as serious injury is sometimes done in greenhouses in midwinter, both as larva and beetle. So far as we know the larva is restricted to the Cucurbitacæ, but the beetles attack other plants. They are flower feeders naturally, but eat also nearly every other portion of a plant, and even cause injury to cucurbits by gnawing the rinds of the fruit. Among other cultivated crops, beans are favorites, and the beetles often congregate in numbers upon bunches of these plants with the result that the leaves attacked die and the pods are rendered so unsightly as to be useless for market. Peas are similarly attacked, as also ripe apples, apple blossoms, the leaves, silk, pollen and unripe kernels of corn.

Of wild plants the beetles evince a partiality for the flower of goldenrod, aster, and sunflower, devouring the colored portions, stamens, pistils and ray flowers. They also frequent the flowers of chokeberry, June berry, cherry, and related plants. In addition they feed freely upon the prickly cucumber or wild balsam apple (*Echinocystis lobata*), a probable natural food plant.

LIFE HISTORY AND HABITS.

The beetles make their appearance in April or May, earlier or later, according to locality and climate, feed upon such flowers as may be in season or on other vegetation, and when cucurbits are set out attack and injure them in the manner previously described.

¹*Neocosmospora vasinfecta* Atk. (*Bacillus tracheiphilus* Erw. Sm.).

The egg was unknown until 1899, a singular fact, considering that this is one of the commonest and best known of injurious insects. It measures 0.6 mm. in length, and varies in color from bright lemon yellow to orange, the length being about twice the width (fig. 1, *d*). The surface, as viewed under a high power microscope, is finely sculptured, arranged in hexagonal pits (*e*).

Although normal oviposition has not come under our observation, we may safely conclude, from analogy, that egg deposition takes place soon after the host plants are well above ground, and that the eggs are laid about the roots and main stems. Mr. F. M. Webster informs the writer that in insectary experiments conducted at Wooster, Ohio, eggs were deposited on leaf-stalks just below the surface of the ground.

The larva is a very slender, white, worm-like creature, with dark-brown head and anal plate and lighter brown thoracic plate.¹

The larval period is passed in the moist earth, about the bases of the stalks, and larvæ may be found within the stems as also upon the fruit where this comes in contact with the earth. This period has been stated to last for about a month, and there is an active stage of this duration in which the larvæ working in numbers have ample time for injuring the vines. When full grown, just before transformation, the larva contracts, having the appearance of being much stouter. Larvæ observed in July remained for three days in this contracted position, and this is probably the usual warm weather quiescent period before assuming the pupa stage. The pupa (fig. 1, *e*) is of nearly the same color as the larva, and its surface is sparsely beset with long spine-like hairs, those on the dorsal surface arising from small, but prominent piliferous warts. This period will vary with climate and season, from six to seven days in warm weather, to perhaps two weeks when colder.

The entire life cycle of this insect has evidently never been ascertained. Considering its long season and the fact that newly transformed beetles have been observed from the second week of July till the first week of October there is comparative certainty of two generations, as generally admitted, each year in the northernmost locality inhabited by the

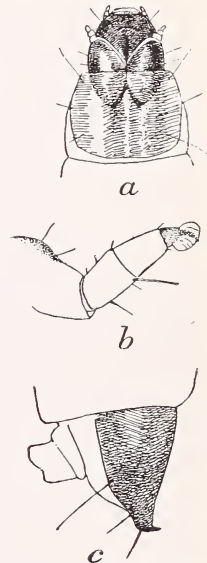


FIG. 2.—*Diabrotica vittata*: *a*, head of larva; *b*, leg of same—anal segment from side—all greatly enlarged (author's illustration).

¹When fully matured it measures about three-tenths of an inch in length, thus being about ten times its width, and presents the appearance illustrated in figure 1 at *b*. It is provided with three pairs of thoracic legs and an anal proleg. Figure 2 illustrates the head and thoracic plate (*a*) a true leg (*b*) and the anal proleg and plate in profile (*c*).

species, and it is safe to assume the existence of three generations annually for the District of Columbia and southward.

Toward the end of the season the beetles congregate under the stems, prostrate portions of plants, and withered leaves of cucurbits, often as many as fifty or sixty individuals assembling about a single plant, and later they seek other places of shelter. The beetles begin to disappear near Washington during the first cold nights of October, but hibernation may commence earlier.

REMEDIES.

Direct applications of poisons will destroy the beetles when they occur in moderate numbers, but have not proved entirely efficacious when the insects are most abundant, hence recourse must be had to preventives and repellents and to certain cultural methods. Living as the larvæ do underground, it is more difficult to reach them than the beetles. Their destruction could be effected by saturating the surface soil about the roots of infested plants with kerosene emulsion.

Covering young plants.—To prevent injury to the young plants early in the season, coverings are used. A cheap frame may be made by cutting a barrel hoop in two so as to form two semicircles, which are then placed at right angles to each other, and the lower ends inserted in the ground with the curve uppermost. Two strong wires bent in the form of croquet arches can also be used. The frame is covered with gauze or similar material, held in place with earth packed about the edges, to prevent the beetles working under it. It is necessary to keep the plants covered only while they are young, and the same covering may be used year after year.

Early planting, etc.—Where no covering is used it is advisable to start the plants in frames or in hothouses, or to plant the earliest varieties and set them out as soon as possible so as to get the plants well established before the appearance of the beetles. In combination with this, the setting out of late varieties should be postponed until after the first appearing beetles have laid their eggs and dispersed.

Planting an excess of seed.—In lieu of the above practices a certain degree of relief can be secured planting an excess of seed so as to distribute attack. After the first danger is passed the hills can be thinned out to the desired number.

A method which has furnished good results in some localities consists in planting the seeds in squares, one each week, as shown in the diagram. The first planting "1" is frequently killed, and may be followed by the second and sometimes the third. As long as the insects are seen they are poisoned, and this is continued until a stand of plants is obtained, as it is seldom that all four plantings are destroyed.

1	2
3	4

Clean culture and trap plants.—Much injury from this as well as other cucurbit enemies would be prevented by more attention to clean methods of cultivation. As soon as a crop is harvested the vines should be covered with straw or other inflammable material and burned, and it would be a wise precaution to have certain plants (*e. g.*, such as might be desired for seed) left standing here and there throughout the fields, so that such insects as may not have been reached by the fire will concentrate on them where they can be easily destroyed with a spray of strong kerosene emulsion or paris green. As traps for the last or hibernating generation, it would be wise to plant later or to use later varieties. By destroying the beetles at this time the numbers for the ensuing year will be greatly diminished.

Some exemption from injury, it is claimed, may be attained by growing beans in connection with cucumbers, for example, in alternate rows. The beans are planted before the cucumbers and the beetles congregate on these plants, and having an abundance of food are not forced by hunger to attack the young cucurbits.

Gourds planted in the vicinity of other cucurbits are claimed to act successfully as a trap, and wild cucumber might produce good results.

Driving with air-slaked lime.—In the melon and squash growing sections of New Jersey "driving" is resorted to as a means of controlling this insect. In the morning when the beetles are active air-slaked lime is dusted over the plants with the wind and the beetles fly before it to the next patch where similar methods will have to be employed or the crop will suffer the consequences.

Arsenites, with ashes, dust, or plaster.—A remedy frequently advised, when insects occur on low-growing plants, is to dust the majority of them with sifted wood ashes, road dust or land plaster, and cover the remaining plants with a solution of paris green or other arsenical, in the proportion of one-fourth of a pound to about 60 gallons of water. The beetles will concentrate on the clean plants, where they will be killed by the poison, not always, however, before they have fed to such an extent that the plants will be more or less damaged.

Dry arsenicals.—Paris green and other arsenicals alone or mixed with plaster, in the proportion of 1 to 75 by weight and dusted over the plants will effectually protect them in many cases.

Pyrethrum, dusted on the plants with a powder bellows, is useful, and the only treatment that is necessary under ordinary circumstances. This treatment is most successful if applied early in the morning when the dew is on. All poisonous and other applications must be frequently renewed and are not generally to be relied upon when the beetles are exceedingly numerous. In case Bordeaux mixture is sprayed on the plants as a protection against diseases, paris green should be added, as it necessitates no additional labor and the mixture will prove more effective against the beetles than would either when used alone.

Kerosene and turpentine.—Another remedy consists in land plaster or gypsum thoroughly saturated with kerosene or turpentine. The vapor of turpentine is reported to be particularly distasteful to this insect.

Tobacco.—One of the oldest remedies, and one that is still in vogue, consists in sprinkling the hills, particularly when the soil is moist, with refuse tobacco dust. It has the advantage of being, like the turpentine and plaster, a good repellent, and also acts as a fertilizer and mulch for the plant.

All these remedies must be repeatedly applied, particularly when rainfall necessitates their renewal, until the plants have obtained a good start or the insects have dispersed.

Stimulating growth.—A considerable degree of exemption from injury accrues from the stimulation of a crop by heavy manuring and frequent cultivation. Fertilizers should be productive of the same results.

With the exercise of good judgment in planting, and combined effort among growers of cucurbits over a considerable tract of country in the use of such of the above-mentioned remedies as may be preferred, the total damage from the striped cucumber beetle should be greatly lessened.

WASHINGTON, D. C., *June 9, 1903.*

